Traffic Accident Location And Analysis System: From Text To Coordinates And Applications

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ABSTRACT

The accident information with precise location is important for improvements of accident-prone locations, planning of safe route to school, and setting geographic differenced safety plans. There is detailed recording of the accidents location in Taiwanese police reports. However, the location description is allowed and given by human semantic with various types, such as the roads at an intersection, the address, well-known building, and the highway mileage. It is very difficult to use current technologies of spatial data for such location descriptions with no coordinates. Therefore, the Traffic Accident Location and Analysis System (TALAS) is developing to handle the police reported accident data in Taiwan to make them can be work on geographic information systems. The purpose of the present paper is to provide some experiences from TALAS.

In addition to automatically purifying the original location descriptions, the TALAS can extracting the meaning words or phrases in the location recording, comparing among various spatial related databases, and obtaining the coordinates of the accident sites among these databases. Furthermore, an accident-prone location analysis module is developed. A dynamic frame methodology is used in this module to give the spatial definition of an accident-prone location as demanded. Finally, a Google Earth with 3D displayed information based on the accident-prone locations is also included in the TALAS.

1 INTRODUCTION

According to statistics in WHO 2004, there are 1.2 million people died of traffic accidents and 50 million people injured every year in the world. The economic loss caused by traffic accidents worldwide is up to 518 billion US Dollars. The estimated information by WHO shows that if no action plan is taken, the ranking of GBD in DALYs for traffic accidents will be increased to 7 in 2030 (as table 1) compared to 8 in 2002. The worst may possible reach to 4. [1] Meanwhile, the international study indicates that the cause of death and disable due to traffic accidents is in top 10 and most death is occurring in developing countries [2-5]. It also shows that traffic accident is a major issue when worldwide health issues are discussed. Comparing to other infectious and non-infectious diseases, traffic accidents are easy to be prevented and can result in obvious improvement such as modifying automobile safety rules can decrease injury level of passengers.

Table 1. The ranking of GBD in DALYs [1]

2002

Disease or injury	% total deaths	Rank
Perinatal conditions	6.6%	1
Lower respiratory infections	6.3%	2
HIV/AIDS	5.7%	3
Unipolar depressive disorders	4.5%	4
Diarrhoeal diseases	4.3%	5
Ischaemic heart disease	4.0%	6
Cerebrovascular disease	3.3%	7
Road traffic accidents	2.6%	8
Malaria	2.3%	9
Tuberculosis	2.3%	10
Chronic obstructive pulmonary disease	1.9%	11
Congenital anomalies	1.8%	12
Hearing loss, adult onset	1.7%	13
Cataracts	1.7%	14
Violence	1.4%	15
Measles	1.4%	16
Self-inflicted injuries	1.4%	17
Alcohol use disorders	1.4%	18
Protein-energy malnutrition	1.1%	19
Diabetes mellitus	1.1%	20
Osteoarthritis	1.0%	24
Vision disorders, age-related	0.9%	25
Trachea, bronchus, lung cancers	0.8%	31

2030

Rank	% total deaths	Disease or injury
1	10.3%	HIV/AIDS
2	5.3%	Unipolar depressive disorders
3	4.4%	Ischaemic heart disease
4	3.8%	Chronic obstructive pulmonary disease
5	3.8%	Perinatal conditions
6	3.7%	Cerebrovascular disease
7	3.6%	Road traffic accidents
8	2.9%	Cataracts
9	2.8%	Lower respiratory infections
10	2.5%	Tuberculosis
11	2.5%	Hearing loss, adult onset
12	2.5%	Diabetes mellitus
13	2.0%	Diarrhoeal diseases
14	1.8%	Violence
15	1.4%	Malaria
16	1.4%	Vision disorders, age-related
17	1.4%	Self-inflicted injuries
18	1.4%	Osteoarthritis
19	1.3%	Alcohol use disorders
20	1.2%	Trachea, bronchus, lung cancers
21	1.2%	Congenital anomalies
32	0.6%	Measles
46	0.5%	Protein-energy malnutrition

In the past, database analysis for hazard location improvement was done by manual which was time consuming and also easy to cause operation error. By using computer software, efficiency can be greatly enhanced which becomes a valuable topic under study. Currently, some analysis system of road accident combined with geographic information system is taken as aided tool. Iowa Transport Safety Department has been promoting PC base Accident Location and Analysis software (PC-ALAS) since 1989.[6] Since then, traffic accident has been obviously improved. In order to enhance the analysis function, Iowa added GIS special analysis function and develop GIS-ALAS system on the basis of PC-ALAS. This system can search accidents information and make report according to the analysis result. In addition, Intersection Magic software is also developed which can help make collision diagram of intersection. The AIMS GIS accident software developed by JMW Engineering, Inc. provides 2 ways of accidents database search, space and properties which can show the collision diagram of selected region or frequency accidents of the region by frequency.[7]

CGIA(Crash referencing system for highway safety analysis) is developed by North Carolina University in USA.(Figure 1)[8] In order to provide complete accident analysis information, CGIA integrate accident map（top left corner screen）, GPS location of accident, accident scene information（bottom left screen）、GIS System（top right corner screen）and road video image（bottom right corner screen）into one computer screen.

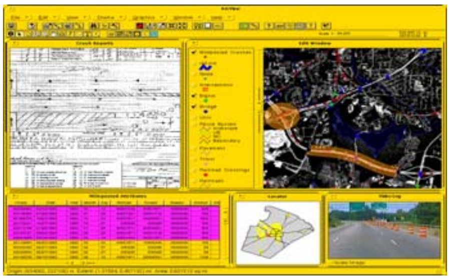

Figure 1. Crash referencing system for highway safety analysis [8]

Thus, this study is reference to the experience of traffic data analysis application software in the overseas and tries to build up integrated TALAS, Traffic Accident Location and Analysis System, by using systematic data analysis procedure. This thesis will introduce the key points of TALAS.

2 METHOD

The accident location written by the police may include intersection, address, building or road miles. Therefore, how to build up consistent content and conduct positioning of accident location in order to get GPS information becomes the major topic of this study. This paragraph will illustrate the research methodology.

2.1 Template database

Template database is used to assist the accuracy of accident information and positioning the location of accident. Five databases as below are used to get the GPS location of accident.

(1). Chunghwa Post Address Database

(2). Institute of Transportation Digital Geo Database

(3). Highway Miles Database

(4). Freeway Miles Database

(5). City/County Address Database

2.2 Analysis of address

The writing format in Taiwan may contain province, county, town, village, street, road, section, lane, number, floor, and etc. There are many different type of address format. In order to compare with the template database and get GPS information of accidents, the address format should follow that of database.

2.3 GPS location of accident

Although the format of address is the same, the content of address may be different. Thus, the format should be consistent (1) consistency of sophisticated and simplified character (2) consistency of number and character (3) consistency of Upper/lower (4) delete of wording (5) delete of space and etc. After building up the address database, the format of accident positioning should be modified. After comparing the modified address with the template database, GPS location of accidents will be generated.

2.4 Merging of Accident Data

The merging of accident location can divide into intersection and road. In considering of speed limit, driver's reaction and vision distance of traffic sign, 75 meter in between the accident spot can be considered as accident area. Because the distance of intersection is not fixed, it is possible the nearby accident data is combined into the accident area. Therefore, it takes more time to process the database to calculate whether there are other accident information is included in the 75 meters range when one intersection database is picked up. Those non-merged data will be deal with in the next step.

The vision distance should be at least 200 meter on the condition of speed at 50 meter per hour. Thus, all the data within 200 meter range of accident scene should be merged. In the practical experience, it is possible to get easy accident area which exceeds 1 kilometer which cannot be taken as reference of accident improvement. (Figure 2) To solve merging problem of intersection and road, Merging-by-Dynamic-Range method is submitted in this study. Before merging, WBS84 should be changed to TWD97 for distance calculation usage. When merging intersection, it needs to select intersection coordinate which is desired to merge and in accord to merging range set, to calculate coordinate of 4 endpoints and using SQL data base, to promptly select data base which fit. (Figure 3) For road section merging, it also needs to select road section coordinate which is desired to merge and in accord to consolidation range set, to calculate coordinate of 4 endpoints and using SQL data base, to promptly select data base which fit.

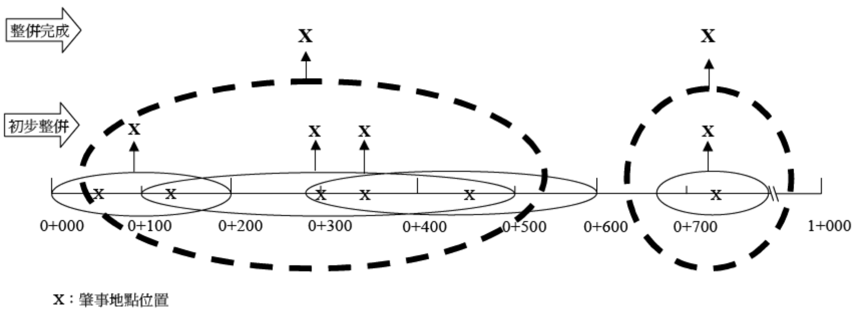

Figure 2.Merging of Accident Data

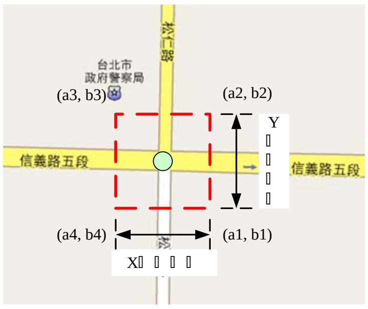

Figure 3. Merging-by-Dynamic-Range method for intersection

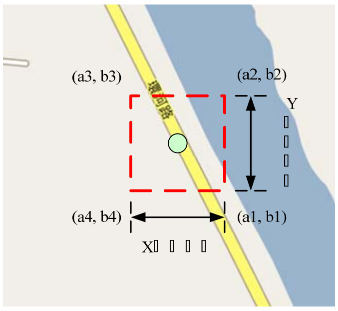

Figure 4. Merging-by-Dynamic-Range method for road section

2.5 Demonstration of database

All the data completed positioning has its own GPS data base which can be shown in Google Earth as below Figure 5.

Figure 5. Demonstration of database with Google Earth

3 Discussion

In Taiwan, accident database can be used not only for statistic analysis in government but also for improvement reference. Thus, the accuracy of accident data fill in will affect the application of database. Although National Police Agency has standard SOP for data fill in but it has different problems in reality. Therefore, how to use existing data for accident positioning becomes the most

important of all for database application.

To solve positioning problem, this study builds up standard process by using systematic analysis and understanding current data base fill in method which can help accuracy of accident positioning. In order to automatically manage, match, position, and consolidate the database, TALAS system is used as integration software platform. The major function module is as below Figure 6 and the major program screen is as below Figure 7 and Figure 8. The main contribution of TALAS system is as follows.

3.1 Successful rate of accident's GPS positioning

There are 160,884 traffic accidents in 2006 and 41,719 accidents' position are unable to identify. 119,165 traffic accidents data had been imported to TALAS system for GPS positioning. Successful rate of accident's GPS positioning is about 78 %.(Table 2)

Table 2. Traffic accidents positioning in 2006

Position items	*Number of Crashes*	successful Positioning Crashes	
		Number	*Percent*
intersection	56,324	42,533	76
Address	41,579	33,263	80
Road miles	16,179	14,312	88
Bridge	3,087	1,259	41
Tunnel	396	14	4
Building	1,600	1,523	95
Total	119,165	92,904	78

3.2 Merging of accident data

It was time consuming and insufficient when consolidating data in manual. After using TALAS system, the accuracy is enhanced and time is shortened. In addition, the possible consolidation range could exceed 1 kilometer under old judgment criteria which couldn't help the improvement of the accident. By using Merging-by-Dynamic-Range method, the range will not exceed 600 meter.

3.3 Hazard location index calculation

TALAS system also provides some index as follows for hazard location identification reference.

(1). Fatalities
(2). Injuries
(3). Crashes
(4). SRI(Relative frequency index of crashes)
(5). SSI(Relative serious index of crashes)

(6). CBI(Combination of SRI and SSI)

3.4 Exhibition with Google Earth

TALAS system can export merged accident data with GPS data in KML or KMZ file formats which can be shown in Google Earth easily as below Figure 9. TALAS system also can export different cities or counties merged data for comparison with Google Earth as below Figure 10.

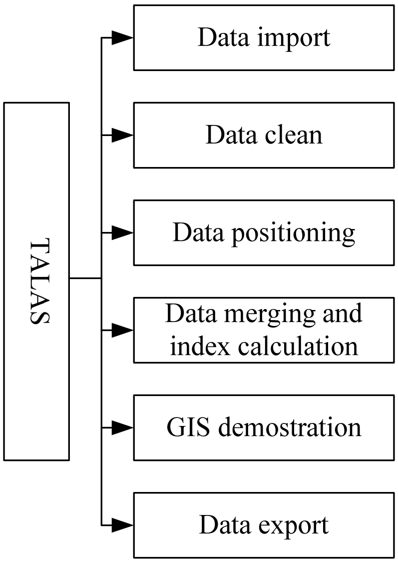

Figure 6.TALAS major function module

Figure 7.TALAS data import function screenshot

Figure 8.TALAS data merging and index calculation function screenshot

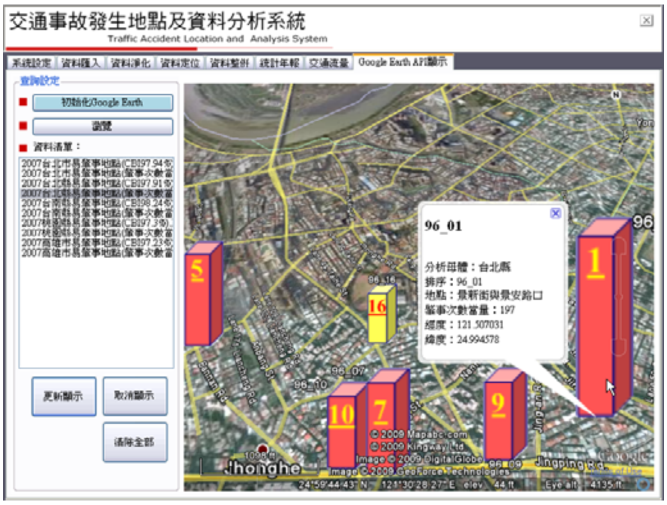

Figure 9.TALAS export merged data in Google Earth easily

Figure 10.TALAS export different cities merged data for comparison with Google Earth

4 Conclusion

To do space analysis function, accident database needs to have GPS location. Although Taiwan accident location collection has been computerized but it still lacks GPS location information. Thus, it needs computer programming. TALA was developed under such circumstances.

It will be the best way to collect accident positioning data by using GPS equipment in the future. But it needs to invest a lot of expenses for this equipment. Therefore, before using this equipment, TALAS can continuously provide proper positioning service.

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